CURRENT COASTAL RESEARCH IN CANADA'S WESTERN ARCTIC

G. Manson[1], D. Forbes[1], J.C. Lavergne[2], M. Craymer[2], J. Hines[3], H. Swystun[4] and T. Milne[5]

[1]Geological Survey of Canada, PO Box 1006, Dartmouth, NS, Canada, B2Y 1E5, [2]Geomatics Canada, 615 Booth St., Ottawa, ON, Canada, K1A 0E9, [3]Canadian Wildlife Service, 5204 50th Avenue, Suite 301, Yellowknife, NWT, Canada, X1A 1E2, [4]University of Northern British Columbia, 3333 University Way, Prince George, BC, Canada, V2N 4Z9, [5]Centre of Geographic Sciences, 50 Elliot Rd. RR#1, Lawrencetown, NS, Canada, B0S 1M0

Relative to other Canadian shorelines, those fringing the Beaufort Sea appear to have particularly high erosion rates due to the presence of ice-bonded, fine-grained sediments and rising relative sea level (RSL). East of Banks Island, shorelines become generally more rocky. Field observations, tide gauge records and ice-loading model results indicate that relative sea level regimes change from rising, through stable, to falling, suggesting decreasing erosion rates from the Mackenzie Delta towards the Coronation Gulf (Fig. 1). In several related and ongoing studies, we conducted fieldwork in the summers of 2001 and 2002 to measure rates of land motion, to revisit and establish coastal change monitoring sites, and to map coastal wetlands and snow goose and swan nesting habitat.

RSL is a function of changes both in land elevation (the isostatic component) and in sea level (the eustatic component). Measurements of both components are required to determine changes in relative sea level due to climate change. To measure land motion, continuous dual-phase GPS monitoring sites have been established at Resolute (NU), Inuvik, Sach's Harbour and Holman (NWT) and epoch sites (where measurements are taken annually over periods of days to weeks) have been established at Mould Bay and Kugluktuk. Land motion results will be used to validate of an ice-loading model and to assist in future model development. To measure sea-level, a tide gauge was established by the Canadian Hydrographic Service at Holman and efforts are underway to establish or re-establish other tide gauges at key locations (Fig. 2). Depending on rates of change, these instruments may take years or decades to produce statistically significant results; in the meantime, the GPS sites act as base stations for precise surveying and the tide gauges provide information on water levels relevant to shipping and communities prone to flooding during storm surges.

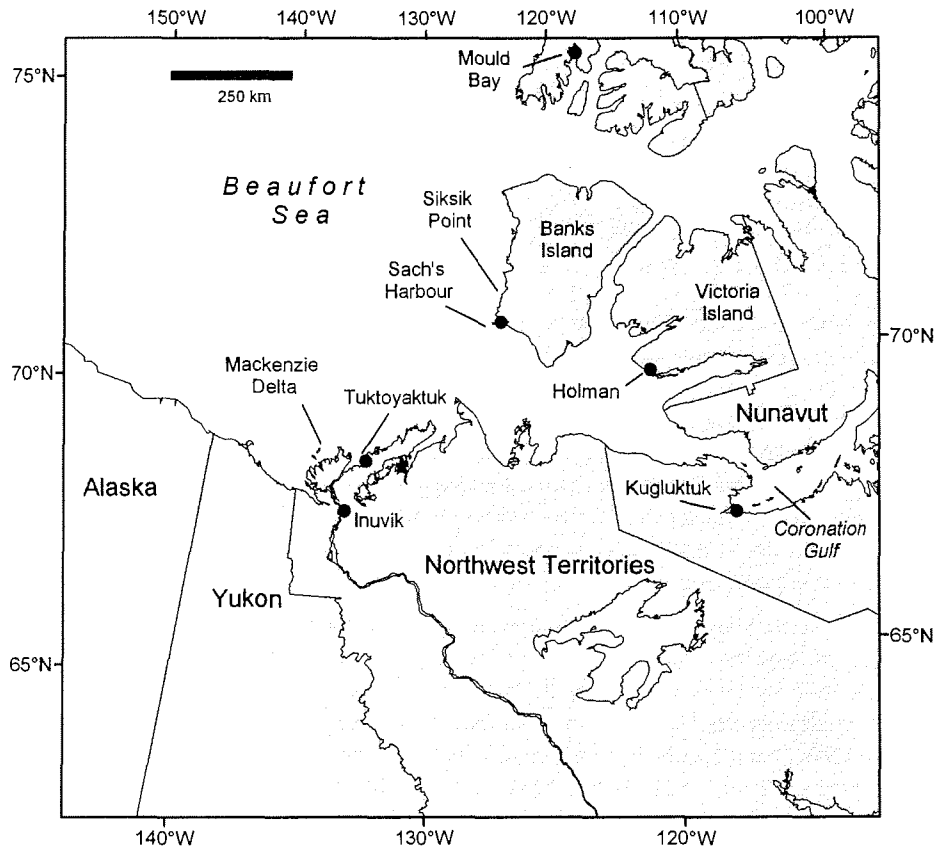

Figure 1. Map of locations in which field work was conducted.

In 2002, erosion monitoring sites on the outer Mackenzie Delta, and at Tuktoyaktuk, and Holman were revisited and new sites were established on the west coast of Bank's Island and at Sach's Harbour and Kugluktuk. Real-time kinematic (RTK) GPS with centimetre accuracy was used to collect cross-shore and alongshore profiles. These profiles were continued offshore using an echosounder with decimetre resolution mounted onboard various small boats and positioned with RTK GPS.

Several approaches were used to position and store observations of coastal wetland plant communities for mapping goose and swan habitats. Three scenes of QuickBird satellite imagery (totalling approximately 375 km^2) were collected at Tuktoyaktuk, Kugkluktuk and an area of western Banks Island at Siksik Point. Launched in October 2001, QuickBird is a passive pushbroom sensor collecting one panchromatic channel (450 – 900 nm) with 0.7 m spatial resolution and four multispectral channels with 2.8 m spatial resolution in the blue, green, red and near-infrared spectral regions (450 – 520 nm, 520 – 600 nm, 630 – 690 nm and 760 – 890 nm, respectively). From satellite ephemeris alone, the spatial accuracy of QuickBird imagery is purported to be 23 m which, with the exception of community mapping conducted by the territorial governments, is thought more accurate than base maps in the Canadian Arctic. Digital orthophotography with accuracy of 3 m exists for the Mackenzie

Delta and will be used to geocorrect the Tuktoyaktuk scene. In the community of Kugluktuk (Fig. 3), imagery will be geocorrected to the community maps.

The described research will contribute to other ongoing projects with national and international scope. These include a national assessment of the vulnerability of shorelines to changing climate, development of climate change adaptation strategies for Canadian coastal communities, implementation of intergrated coastal zone management and Canada's Oceans Act and contributions to the Arctic Coastal Dynamics Project and the Intergovernmental Panel on Climate Change.

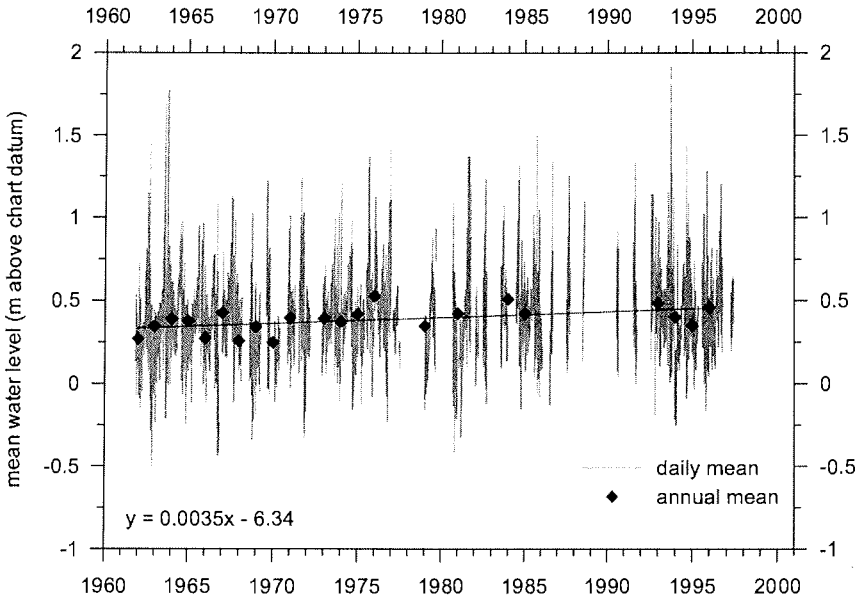

Figure 2. The tide gauge record from Tuktoyaktuk showing daily and annual means. Regression of annual means for years with nearly complete data from 1961 to 1997 gives a statistically significant ($\alpha = 0.05$) rate of relative sea-level rise of 3.5 mm/a.

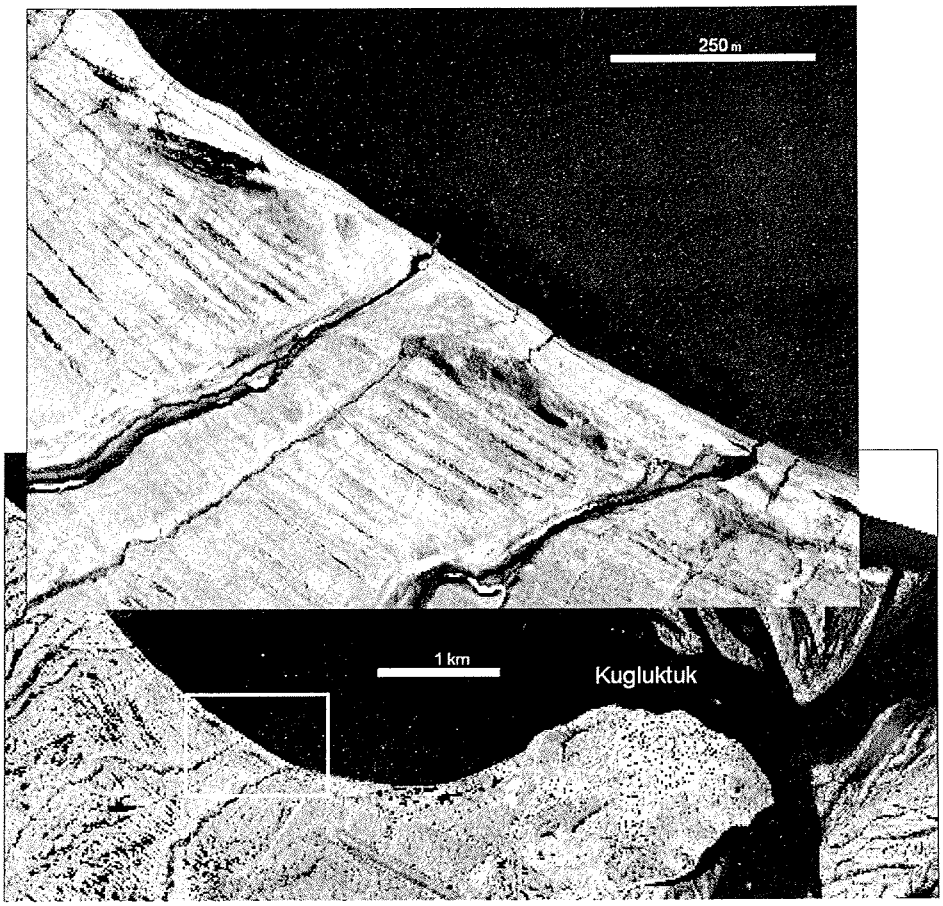

Figure 3. Panchromatic QuickBird imagery showing part of a mosaic of the Coppermine River delta and community of Kugluktuk. The inset (area of box) shows raised beach deposits intersected by gullies and ice wedge polygons.